(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
10 July 2003 (10.07.2003)

PCT

(10) International Publication Number
WO 03/056791 A1

(51) International Patent Classification[7]: H04M 1/72

(21) International Application Number: PCT/CA02/00018

(22) International Filing Date: 4 January 2002 (04.01.2002)

(25) Filing Language: English

(26) Publication Language: English

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(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

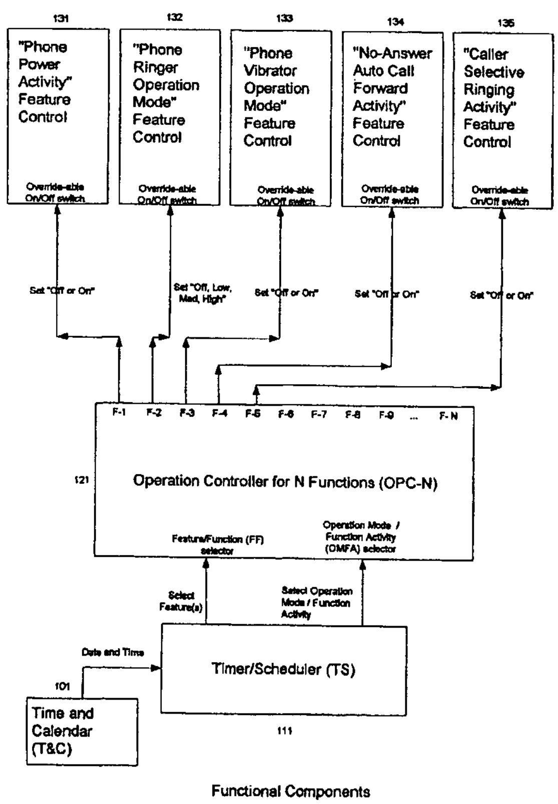
(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:
— *of inventorship (Rule 4.17(iv)) for US only*

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD AND SYSTEM FOR SCHEDULING FUNCTIONS OF WIRELESS STATION EQUIPMENT



(57) Abstract: A wireless communications device function scheduler having an input means for obtaining a schedule of the desired states of applicable functions, and a control means for effecting such states for their corresponding time interval(s) as specified in the schedule; for scheduling the operation modes and activities of a plurality (one or more) of features/functions of wireless station equipment. The function scheduler temporally manages functions or features that support incoming and outgoing communications on the wireless communications device, thereby facilitating the optimal use of the device as well as reducing its unnecessary power consumption.

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METHOD AND SYSTEM FOR SCHEDULING FUNCTIONS OF WIRELESS STATION EQUIPMENT

FIELD OF THE INVENTION

The present invention relates generally to telecommunications equipment and, more particularly, to a method and system for scheduling an operation mode and an activity (activation/deactivation) of a function of a wireless communications device.

BACKGROUND ART

Modern wireless station equipment or communications devices have many functions or features for handling incoming communications. For instance, the user of a wireless communications device can completely disable all notification of incoming messages and calls. Alternatively, the user can disable audible signals (for example, ringing and beeping) while enabling motional signals (for example, vibration) for notification of incoming messages and calls. For example, going to a movie, the user may disable the ringer/beeper and enable the vibrator when the movie starts, and enable the ringer/beeper and disable the vibrator when the movie ends.

In addition, the user may have a regular schedule in which certain operation modes of the device functions and the activation/deactivation of some device functions are desirable. For example, going to a weekly social gathering between 7pm and 9:30pm on Wednesdays, the user may desire to disable the ringer or beeper of his cellular phone or pager but enable the vibrator while the device is powered on. (That is, the desired operation mode of the ringer or beeper function of the device is off (silent) and that of the vibrator is on, while the power function is activated.) There are cellular wireless service providers that provide calling plans which include unlimited free calling at certain time

intervals, for example, at lunchtime between 12pm and 1pm and during evenings and weekends. Consequently, the user might like to turn off his phone completely outside these free-call intervals. Currently, the user needs to enable/disable and activate/deactivate the wireless device functions manually, and cannot do so until the desired dates and times or moments occur. If the desired operating state of a function is periodic, the user must manually enable/disable and activate/deactivate the given function in accordance to the desired state for each interval or moment. Failure to do so may result in missed notification of messages and calls. For example, during a regular social gathering, the user might forget to turn off the ringer, while keeping the vibrator on. That is, the user does plan to be alerted of incoming calls, but does not wish to alert others audibly around him. The same user might have remembered to turn off the ringer, but forgot to turn it on after the regular social gathering has ended. Hence he may miss calls while the phone is placed in his jacket because he places the jacket in the passenger's seat while driving or on the chair while dining. Even if the user may be so diligent that he manages to set his wireless device as planned without mistakes, the effort to execute the plan represents an undue burden on him.

U.S. Pat. No. 5,768,363, "Programmable Timer Circuit for the Signal Generator of A Communication Device" discloses audible signals solely as the means to notify telephone users of incoming calls. With modern communications, the user might still want to receive the incoming calls even if he disables the audible ringer, for example, in a movie, meeting, social gathering, etc. In addition, the patent discloses the use of a timer circuit to control the audible signal generator when an incoming call occurs. The telephone system is driven solely by an incoming signal coming from outside the device, and the decision to act on that incoming signal requires a comparison of the time of this incoming signal with the preprogrammed times and intervals under which notification has been enabled.

The ringer function is just one of many functions that the user can use to manage his incoming calls. These functions include vibrator, caller identity display or alert, selective call blocking, call forwarding, and so on. Furthermore, the user's turning off the ringer does not necessarily mean the user does not want to be notified of the incoming calls. He can subsequently answer the call without the ringing (or even the vibration), relying on

just the visual flashing or illumination of the phone's LCD or some other visual indications. Hence, the user of a cellular phone (or a wireless communications device in general) cannot adequately rely only on the ringer function to manage the notification of his incoming messages/calls. Consequently, the management of incoming communications on wireless communications devices is continually enhanced with the use of various notification functions.

Furthermore, one of the major limiting resources with wireless communications is the battery life of the wireless devices. As a battery saving measure, it is desirable to turn off the power of the devices whenever the user does not want to receive or be notified of any incoming calls, for example, during the high-tariff calling time intervals or when he is asleep.

SUMMARY OF THE INVENTION

The present invention provides a method and system for scheduling a plurality of wireless communications device functions in a coherent manner. A feature or function, such as ringer, vibrator, power, caller identity display, no-answer auto call forward, and so on, comprises various operation modes. The basic operation modes are ON and OFF. For some functions, different degrees of "ON" state are also possible, for example, low, medium, and high, as well as escalating. Furthermore, more than one function may be grouped together within a profile. A profile comprises one or more functions that assume specific operation modes or function activities to be effective for a specific interval or time.

The present invention enables a user of a wireless communications device to instruct, in advance, the device how and when to handle the notification of incoming calls, without having to wait until the desired effective dates and times occur. Nor does he need to remember the desired effective dates and times as well as the desired effective states of the functions. Moreover, setting an operation mode of a function does not mean activating

or deactivating the function. For example, setting the operation mode of a ringer function to "High" does not immediately result in the device ringing in high volume; it sets up the ringer function so that the device will ring in high volume when an incoming communication occurs. Both the operation mode and the activity of a function constitute the state of the function.

Furthermore, the present invention allows the user to manage his outgoing communications by associating an outgoing communication with an event in a user schedule, and to reduce unnecessary power consumption by having the device turned off at preprogrammed dates and times or intervals.

Further objects and characteristics of the present invention will become apparent from a perusal of the drawings and ensuing description. However, the description and drawings are designed solely for purposes of illustration, and should not be regarded as a definition of the limits of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates various functional components pursuant to the invention.

FIG. 2A to FIG. 2C show example data tables used by a Timer/Scheduler (TS) component, according to the invention.

FIG. 3 shows an example flowchart of how a Timer/Scheduler (TS) component may operate based on the data tables shown in FIG. 2A to FIG. 2C, according to the invention.

FIG. 4A to FIG. 4B show example data tables used by a Timer/Scheduler (TS) component to communicate with an Operation Controller (OPC) component, according to the invention.

FIG. 5 shows an example hierarchy that illustrates how activities of some features can override those of other features, according to the invention.

FIG. 6 shows an example flowchart of how a user programs a Timer/Scheduler (TS) component, according to the invention.

DETAILED DESCRIPTION

FIG. 1 ("Functional Components") shows the functional components of an illustration for the present invention. The functional components as seen in FIG. 1 are:

- Time and Calendar (T&C) – 101
- Time/Scheduler (TS) – 111
- Operation Controller (OPC) – 121
- Six Feature Controls (FCs), together controlling the activation/deactivation and/or operation mode setting of six features: Phone Power (function activity) – 131, Phone Ringer (operation mode) – 132, Phone Vibrator (operation mode) – 133, No-Answer Call Forward (function activity) – 134, and Caller Selective Ringing (function activity) – 135.

The "Time and Calendar" (T&C) component provides calendar dates and times to the "Time/Schedule" (TS) component. The TS component may request the date and time information from the T&C component, or the T&C component may periodically send such information to the TS component. Such periodical transmission of information by the T&C component allows the TS component to perform, via the Operation Controller (OPC) component, a state change of a wireless device function based on a schedule as given by the user. Such state changes include setting a specific operation mode of a wireless device function and activating/deactivating a specific wireless device function. The OPC component provides the interface to translate the operation mode and function activity setting directives from the TS component into the corresponding signals that

individual Feature Control (FC) components receive to effect the changes to their corresponding features or functions (such as Phone Power, Phone Ringer, and so on).

Note that the functional components described herein do not necessarily represent a distinct entity. For example, multiple FC components may be combined into a single functional component. The functionality of the OPC component may be assimilated between the TS and FS components. The functionality of all components may further be consolidated into a single functional component. Furthermore, the functionality of all components may be distributed across the existing platform upon which the present invention is to be carried out. That is, a functional component of the present invention is a construct that represents a part resulting from a specific decomposition of the present invention. The decomposition chosen for detailed description provides a simple and logical illustration of the present invention. One who is skilled in the art of wireless device technology and development can readily find another decomposition to carry out the present invention.

Definition

The following terms are defined for use in this description:

Call – A communication that requires an initial set up of a connection before the communication can take place. Note that a call is not necessarily for voice communications only; for example, a modem data communication or simply the act of logging into a network may be considered to be a call.

Communications device – a piece of equipment that interacts with its user (a human operator, a machine, or a system) to enable the user to communicate with another user.

Communications means – a method, instrument, or process that facilitates exchange or delivery of information for its user, such as a telephone, a fax machine, a modem, and so on.

Control means – a method, instrument, or process that can put the system under its influence to a particular state that it desires, such as a microprocessor, a circuit, a piece of software, and so on.

Feature – a capability of a (communications) device that performs a specific task from a user perspective, such as ringer, vibrator, power, and caller identity display.

Function - a capability of a system that performs a specific task; in general the term can be used interchangeably with the term "feature" when the capability performs a user-level task, or the task so performed results in a user-visible change.

Input means - a method, instrument, or process that facilitates input of information from a user, such as a keypad, a voice recognition receiver, and so on. In particular, an input means for the present invention from a user perspective may not reside on the communications device. For example, the user or his office assistant may input his profiles on his personal information management system on his laptop or at a web site, and then the personal management system downloads such profiles onto the device. Note that such downloading mechanism is considered an input means with respect to the device.

Message – a communication that does not require an initial set up of a connection before its transfer. A message and a call together constitute all forms of information exchange.

Operation mode – the behavior of a feature or function in a particular way when made active.

Output means - a method, instrument, or process that facilitates output of information to a user, such as verbal responses system, characters and graphics display, and so on.

Personal Digital Assistant (PDA) – a portable handheld device or application system that provides management of user information, such as storing a calendar and an address book.

Power source – the supply of power to a device, and the generation of the power may be of various natures, such as solar, fuel cell, and electrical, and may come from multiple generators.

Profile – a set of events for effecting changes on the state of a communications device.

Station equipment – a piece of equipment at the user's premises that transmits and/or receives user information (traffic), and exchanges control information with the network to place calls and access services from the networks.

Wireless communications device – a communications device that exchange messages and/or calls wirelessly.

Wirelessly – in a manner that does not require permanent physical connections. Wirelessly includes microwave, radio, and optical signals.

Time and Calendar (T&C) Component

A T&C component keeps the current date and time. The initial date and time may be set by the user, or by other time keeping systems external to the device. As such, adjustments such as daylight saving time and time zones may be done accordingly. The

required granularity of the date and time is based on the granularity of the schedule in the TS component. For example, if the TS component allows the users to specify in the schedule dates and times down to the level of milliseconds, then the T&C component must keep the date and time to an equally fine or finer granularity. For the purpose of illustration, this document uses days of week and the 24-hour time, with minutes as the finest granularity. Hence, every minute, the T&C component described herein will provide the day of the week and the time in the format "hh:mm" to the TS component, where "hh" is the hour in 24-hour format, and "mm" is the minute. (The T&C component may alternatively provide the TS component with a delta between the current date and time and a common epoch, such as a fixed date and time or the last synchronized date and time.)

Timer/Scheduler (TS) Component

A TS component based on a schedule and the current time decides which feature/function to activate/deactivate or to set its operation mode at any given time. In addition to an unorganized set of functions and their preprogrammed dates and times or intervals, a schedule may comprise multiple profiles. From a user's perspective, each profile comprises a number of user-selected parameters including: a group of features/functions, the profile activation (start) date and time, and optionally the profile deactivation (end) date and time, as well as the target operation mode and/or function activity for each feature/function in the group at the moment of profile activation/deactivation. Each profile can also be identified by a unique profile identifier (ID) and given a profile description. As an illustration, the information in such a schedule is disseminated into three data tables as shown in FIG. 2A ("TS Profiles Table"), FIG. 2B ("Timer Trigger Table"), and FIG. 2C ("Feature Operation Mode / Function Activity (FOMA) Specification Table"). The length of each of these tables corresponds to the number of profiles that the TS component supports. In those figures, four profiles are supported. These tables are kept in non-volatile store (NVS), such as EEPROM (Electrically Erasable Programmable Read-Only Memory) and hardware registers.

The data table called "TS Profiles" (FIG. 2A) contains profile IDs and profile descriptions. In addition, it contains other data for internal use by the TS component. For example, the "Saved" Boolean data indicates if the profile has been saved by the user. (A Boolean data is one that can assume only one of two values, for example, "true" and "false", or "yes" and "no".) An unsaved profile means the profile is either unspecified or under specification, and hence not available for the TS component to use. The "Suspended by User" Boolean data indicates if the user has temporarily suspended the profile. Suspended profiles are saved, but temporarily not available for the TS component to use. The "Trigger Record Number" data provides the reference to the corresponding entry in the Timer Trigger Table (FIG. 2B). Similarly, the "Feature Operation Mode and Function Activity Specification Number" data provides the reference to the corresponding entry in the Feature Operation Mode / Function Activity (FOMA) Specification Table (FIG. 2C). (These three tables, FIG. 2A to FIG. 2C, can easily be amalgamated into a single table, thereby eliminating the cross-table references and other redundant data fields.)

A Timer Trigger Table comprises trigger records, each of which maintains the profile activation (start) dates and times and the profile deactivation (end) dates and times. The start and end dates illustrated by the Timer Trigger Table in FIG. 2B are days of the week. The moment upon which a timer event such as a profile activation/deactivation is to take place is called a trigger instance. A trigger instance in a schedule illustrated by the Timer Trigger Table in FIG. 2B comprises a start or end trigger day, and a start or end trigger time.

A trigger instance pair (TIP) number identifies the two corresponding start and end trigger instances, if any. (That is, the interval for a preprogrammed operation mode or function activity may be open-ended in that there may not be an end date and time specified.) For example, in FIG. 2B, trigger record number 2 has four pairs of trigger instances. The first pair is identified by the TIP number "1", and it starts on Monday (19:00) and ends on Tuesday (07:00). The next pair is identified by the TIP number "2", and it starts on Tuesday (19:00) and ends on Wednesday (7:00), and so on. A TIP number also distinguishes a start trigger instance from other start trigger instances within the same

trigger record. As such, a TIP number is assigned to a trigger instance, even if the (start) trigger instance does not have a counterpart (end) trigger instance.

Each trigger record also contains other data for internal use:

- The "record state" indicates whether the trigger record is suspended (hence complete but not in effect), is active (hence complete and in effect), or is deleted (hence the record may be used for a new profile).
- The FOMA Specification Number, which is also available at the TS Profiles table (FIG. 2A), is duplicated in the Timer Trigger Table so that the TS component processing the Timer Trigger Table can readily perform the function state changes without referring back to the TS Profiles table.
- The Current Trigger State (CTS) keeps track of which trigger instance is in effect. For example, "Start-3" means that the start trigger instance with the TIP number "3" is now in effect. (In Record #2 in FIG. 2B, "Start-3" is Wednesday 19:00.) "Start-0" or "End-0" means that none of the trigger instances is in effect.
- The "End?" Boolean data indicates if there is any end trigger instance in the trigger record.
- The "Number of Repeats within Week" (NRW) data indicates how many times the specified pair of trigger instances or, if unpaired, how many times the specified start trigger instances are to repeat throughout the week. For example, there are four pairs of trigger instances for Record #2 in FIG. 2B, so the NRW data shows a value of 3.
- The "Weekly?" Boolean data shows whether the trigger instances are repeated weekly. If the trigger instances in a trigger record are not weekly, then the record will be deemed "Suspended" once the last trigger instance is served. The user can then choose to reinstate the record, or delete it. If the trigger instances in a trigger record are weekly, then all the trigger instances in the record are automatically reinstated after the last trigger instance has been served. For example, after the end trigger instance with TIP number "4" in Record #2 in FIG. 2B is served, the target or next trigger state will be the start trigger instance with TIP number "1" in Record #2.

The TS component uses the CTS, "End?", NRW, and "Weekly?" data of a trigger record to operate on the trigger instances in the trigger record. When a trigger record is created, the CTS is set to "Start-0" for a trigger record that does not have end trigger instances ("End?" equal to False), or to "End-0" for a trigger record that has end trigger instances ("End?" equal to True). The trigger instance(s) based on which other trigger instances repeat assume the TIP number "1", while the repeat trigger instances assume chronologically the TIP numbers "2", "3", "4", and so on. For example, in FIG. 2B, record #2 shows that it has the start and end trigger instances with the TIP number "1" are Monday 19:00 and Tuesday 07:00 respectively. Then the start and end trigger instances that repeat for these trigger instances are assigned the TIP numbers based on their chronological relationships among one another. The start and end trigger instance pair closest to the pair with TIP number "1" is assigned the TIP number "2"; the next closest is assigned the TIP number "3"; and so on. NRW records the number of repeats in the record. (Note that these internal-use data such as CTS, "End?", and "NRW" are not required. The TS component can readily operate based solely on the user-provided schedule information. The use of such internal-use data facilitates a simple illustration of how the TS component can process user-provided schedule information.)

When a trigger record is put into effect the first time or when it is reinstated (i.e., record state changed to become "Active" from some other states), CTS needs to be updated. First, the present moment or current date and time is chronologically compared with the dates and times of the trigger instances in the trigger record. Then CTS will be the trigger instance that chronologically and immediately precedes the current date and time. For example, if the user enters on Wednesday 10am a profile that results in the creation of Record #2 in FIG. 2B, then CTS for Record #2 will be "End-2" (that is, end trigger instance "Wednesday 07:00"). (If a start trigger instance has not been in effect, the target state changes for the end trigger instance in the same trigger record should not take place. The record state and CTS would have shown "Active" and a start trigger instance respectively to indicate a start trigger instance was in effect. On the other hand, if the trigger record is put into effect for the first time or reinstated during an interval of the profile that the trigger record belongs to, the target state changes for the start trigger instance should take place.) Subsequently, when the day of the week and the time are

Wednesday and 19:00, then the state changes corresponding to Record #2 in FIG. 2B are asserted accordingly (as specified in FIG. 2C), and CTS becomes "Start-3". If the current date and time is prior to the first start trigger instance (i.e., with TIP number "1"), then the CTS of the record upon profile activation is either "Start-0" (for unpaired trigger instances) or "End-0" (for paired trigger instances).

If there are no end trigger instances (i.e., there are unpaired trigger instances), CTS progresses from "Start-0" to "Start-1", then from "Start-1" to "Start-2", and so on, until it reaches the last trigger instance (i.e., "Start-<last>", where <last> is one plus NRW). If there are end trigger instances (i.e., paired trigger instances), CTS progresses from "End-0" to "Start-1", then from "Start-1" to "End-1", and then from "End-1" to "Start-2", and so on, until it reaches the last trigger instance (i.e., "End-<last>", where <last> is one plus NRW). When CTS reaches the last trigger instance, the record will be in the "suspended" state if the trigger instances are not weekly (i.e., "Weekly?" equal to False). If the trigger instances are weekly (i.e., "Weekly?" equal to True), then the record remains in the "active" state, and the CTS progression will "wrap" around. That is, the target trigger state (i.e., the next CTS) will be "Start-1". FIG. 3 shows how a TS component may process the Timer Trigger Table in FIG. 2B.

The Timer Trigger Table should be re-examined to bring the state of each function (i.e., the operation mode and its function activity) up to date whenever there is a discontinuity of current date and time (for example, day light saving time), or a discontinuity of the operation of the TS component (for example, the total power off of the wireless device, like the removal of its power source).

For example, when the system of the present invention first powers up, the T&C component will initialize its date and time information from the phone itself, which may obtain such information from base stations or the wireless networks. (Upon system activation, all "Active" trigger records should be treated as transiting from an unknown state to "active" state, so that the algorithm for determining CTS upon record activation may be re-used to handle system activation for the trigger records.)

FIG. 2C shows an example Feature Operation Mode / Function Activity (FOMA) Specification table. A FOMA specification table comprises a number of FOMA specifications, each of which is identified by a unique number. The specification number is referenced in both the TS Profiles and the Time Trigger tables, and associated with an entry in each table. Each entry in a FOMA specification table lists the profile-start and profile-end operation modes or activities for each feature. Hence if a profile is to be started, then all the profile-start operation modes and activation/deactivation corresponding to the profile are effected. If a profile is to be ended, then all the profile-end operation modes and activation/deactivation corresponding to the profile are effected.

To effect such feature/function state changes, the TS component signals the OPC component, which serves as an intermediary to Feature Control components that actually effect the state changes to the features/functions in question.

Operation Controller (OPC) Component

An OPC component accepts two inputs (from the TS component): Feature/Function (FF) selector and Operation Mode / Function Activity (OMFA) selector. FIG. 4A ("Function Selection Table for an Operation Controller for 8 Functions") shows an example function selection table for eight features/functions. To allow multiple features/functions to be addressed at the same time, the function identifier contains the same or more number of bits (binary zero or one) than the number of functions. Furthermore, each bit is significant with respect to only one feature. FIG. 4A shows Function 1 (F-1) has an identifier of "00000001", where the significant bit is the last bit from the left (first bit from the right). That means whatever values (0s or 1s) the other bits assume are insignificant to the F-1 feature. Function 8 (F-8) has an identifier of "10000000", where the significant bit is the first bit from the left. FIG. 4A also shows how the functions correspond to the state change request output interfaces on the OPC component. These interfaces communicate with the Feature Control (FC) components that make their respective features/functions operate per desired operation state, as instructed by the OPC component.

FIG. 4B ("Operation Mode Selection Table for a Quaternary Operation Controller for 8 Functions") shows an example operation mode / function activity selection table for eight functions, and that each function may have up to four different operation modes or function activities. Hence, 16-bit values are accepted by the OPC to determine what operation modes and function activities and for which features/functions are to be controlled by the TS component.

The OPC component provides a number of output interfaces, one for each state change of a function that the OPC component has an interface with. Each output interface can produce the appropriate signals that the respective Feature Control (FC) component can understand. The OPC component serves to shield a TS component from providing the actual mechanisms to effect the state changes of the function/feature in question. For example, to turn on the phone power, the OPC component may turn on an electronic switch. To change the volume of the ringer, the OPC component may write a value from one to four to an electronic memory location.

Note that the above approach by the OPC component to serve as an intermediary between the TS component and the FC component is just one of many possible ways. For example, the OPC component may solicit input and provide output for each function one at a time instead of allowing simultaneous input and output, thereby requiring much less number of bits at the interfaces with the TS and FC component. Similar to the tables used by the TS component illustrated earlier, the above approach as depicted in FIG. 4A and FIG. 4B facilitates a simple illustration of how an OPC component can typically serve as an intermediary between a TS and a number of FC components.

Feature Control (FC) Component

A feature control (FC) component may be circuitry, or it may simply be an interface that has the provision to control the respective feature or function appropriately. For example, there may be memory address for each feature into which one can write certain

numerical commands or values (like 0 and 1) that will result in the feature being in the desired state, whether setting an operation mode or activating/deactivating a function, or both. A separate FC may be used for setting the operation mode and for activating/deactivating the same function if both changes to the operation mode and function activity are needed separately and independently. For example, if the ringer function is used to provide an event-reminder alarm in addition to incoming call notification, the former requires that the ringer be activated at the preprogrammed dates and times, while the latter does not. Moreover, activating a function in its "off" mode does not result in the function operating (i.e., being active).

Each FC component provides an input that accepts signals or commands on behalf of the state control that it represents. The input should be override-able so that the user may override the operation mode or function activity set by the OPC component through other interfaces, e.g., the power button to turn on or off the phone power (that is, not via the TS component). However, such user overrides do not change the settings of the OPC output to the FC components. Such override-able characteristics may be realized by implementing a latch in each FC component, which registers the last received operating state directive either from the OPC component or from other means (such as manual user control).

FIG. 5 ("Example Feature Overrides Hierarchy") shows a hierarchy of how the activities of some features may override those of other features. For example, if the phone power is off, then activating the phone ringer or vibrator is of no consequence, because their activation is conditional on the phone power being on. Similarly, the phone ringer and vibration features themselves can override or interfere with other features, such as the "caller selective ringing" feature, which will activate the ringer and/or vibrator only for pre-selected incoming communications. (Such selection may be based as on the identification of the equipment or person that initiates the communications, or some accompanying control code, etc.) Some overrides are logical, for example, no ringer or vibrator activation when the phone power is off, or no automatic power off when the user is currently receiving and sending incoming and outgoing communications (with possibly an alert to indicate that the device has been scheduled to turn itself off). However, some

overrides are arbitrary. For example, the ringer and vibrator may still be activated under the "caller selective ringing" feature for a pre-selected incoming communication, even when their operation modes are "off" under the "ringer" and "vibrator" features. Hence, the "caller selective ringing" feature is made to override the "ringer" and "vibrator" features. On the other hand, the "caller selective ringing" feature may not make any provision to activate or change the operation modes of the "ringer" and "vibrator" features, thereby depending solely on their current operation modes at the time the pre-selected incoming communication occurs. Hence, the "caller selective ringing" feature is seen override-able by the "ringer" and "vibrator" features. The present invention does not stipulate any particular feature overrides scheme, which could be fixed for or configurable by the user.

PREFERRED EMBODIMENT

The present invention may be implemented for a wide variety of wireless devices, from typical cellular phones to the wireless phone-equipped personal digital assistants (PDAs). This section describes the embodiment of cellular telephones (PDA-based or otherwise), which have the typical means for user input, such as keypads and voice recognition receivers, and for system visual output, such as LCD (Liquid Crystal Display), TFT (Thin Film Transistor), and plasma screens. The features are phone power, phone ringer, and phone vibration. (Note that modern cellular phones can also accept messages such as text and data. A separate set of notification functions may be desirable, such that the user can still be notified of an incoming message audibly even when the ringer is turned off. In this illustrative preferred embodiment, the phone ringer covers the audible alerts resulting from incoming messages as well.)

FIG. 6 ("Timer Programming Flowchart") shows how a user may enter the TS profiles. The information of these profiles is stored in electronic/optical memory. FIG. 2A to FIG. 2C show how such information may be stored. Data manipulations are required. For example, if the user enters the length of time instead of End day and time, then the system would calculate the End day and time based on the length of time. The user input data translations required to store the user-input information into the data tables such as FIG. 2A to FIG. 2C are trivial. Anyone who is skilled in the art of software engineering can readily provide the software (logic) to handle such manipulations automatically.

In addition, the user can attempt to specify a potentially conflicting schedule. For example, a start day and time of "Monday" and "10:00" with an end day and time of "Wednesday" and "20:00" cannot be repeated anytime for "Tuesday", since "Tuesday" is within the duration of the trigger instance pair. Either the user interface may detect the problem and force the user to correct it, or the system simply accepts such user input. For the latter case, the expected behavior should be described. For example, should the repeat pair – "Tuesday 10:00" and "Thursday 20:00" – be ignored, or given a chance to execute?

Moreover, a scheduling conflict arises when two or more profiles have the same function but with a different operation mode and/or function activity to be asserted at the same time. Potential scheduling conflicts arise when there are overlapping intervals between two or more profiles involving a same function. An embodiment may limit itself to activate only one profile at a time to avoid such conflicts. On the other hand, an embodiment may allow activation of multiple profiles without any restriction. Other alternative embodiments may use variations between these two approaches.

In this embodiment, the functional components are realized within the special-purpose integrated circuits or field programmable gate arrays (FPGAs) of the cellular phone. The embodiment includes software that is capable of processing user schedule information. An example is shown in FIG. 3 ("Timer Processing Flowchart"). FIG. 3 describes the steps to process the data tables used by the TS component every minute. As such, the T&C component provides date and time information to the TS component every minute. In addition, user schedule information and any required internal states to the embodiment are stored in NVS, such as EEPROM and non-volatile RAM (random access memory) inside the embodiment, or flash or SIM-type cards that are removable from it.

The power to the components (including the T&C component) comes from the cell phone power source. The user-perceived power function's on/off does not affect the operation of the present invention and as such all of the functionality of the present invention remains powered at all times. The user has the option to turn off the whole system (of the present invention) so that no power will be consumed by the system. Naturally with the system in the off state, all the profiles as input by the user will be rendered ineffective.

Note that the operation mode of a power feature may be "standby", in that when the power feature is activated, the device only provides power to some autonomous operations, for example, running the calendar clock. Deactivating the power feature would result in no power delivered to the device at all, hence stopping any autonomous operations. (Note that this power feature example is for illustration only; an independent power feed generating from the same or different power source can provide for

autonomous operations, and work independently from the user-perceived powering for the non-autonomous operations, such as receiving a call.)

With respect to the user input, a typical cellular phone described above will allow proper entering of profile information. A more sophisticated platform may provide a different profile entry experience. For example, on a PDA platform, a timely event may be associated with a profile. The profile can also become the event itself, with its description or name shown on the PDA calendar covering a single or set of time intervals. Granularity of schedule programmability can change from relative time intervals (e.g., from now for 2 hrs) and specific time periods within a 24 hr cycle (like 11pm to 6am) to a full PDA-like calendar.

One who is skilled in the art of software engineering and hardware engineering, as well as mobile phone design will be able to realize the embodiment described herein. Furthermore, it should be understood that while the present invention has been described in reference to an illustrative embodiment, other arrangements, realizations, and modifications would be apparent to those of ordinary skill in the art.

IMPLEMENTATION

While in the preferred embodiment, the functional components of the present invention are realized within the devices, Note that it is possible to locate a part of or the whole of a functional component external to the devices. For example, a T&C component may use infrared or radio signal to send the current date and time information to a TS component. Functionality of some functional components described above may also be consolidated or simplified depending on the platforms in which the embodiment is to be realized. For example, on a PDA-based wireless device, the T&C and TS components may be extension of time keeping and time comparison functions in the PDAs. In addition, a new software component to the PDAs may be all that is required to enable the

PDAs to directly control the setting of operation modes and function activities. (Thus OPC and FC components may be realized in software.)

Moreover, different schedule programmability will inevitably affect the design described above, and thus the implementation will change accordingly. For example, a cellular phone or a PDA can often generate an alarm for a pre-programmed timely event. The present invention can make use of this existing mechanism to effect the required operation mode changes and function activation/deactivation. For example, some cellular phone and PDA platforms on which applications and features are developed provide various levels of programming interfaces so that the present invention can be realized solely by programmatic means. One who is skilled in the art of software development and the art of development of wireless communications devices will be able to realize or adapt the present invention into a specific embodiment.

Furthermore, the same functional requirements on a given platform may be realized differently. For example, the detailed description above depicts an implementation that de-couples the operation of a TS component with that of the incoming call handling mechanism. That is, whether there are incoming calls does not affect the operation of the TS component, and the TS component operates independently of incoming communications signals, thereby not interfering with the incoming call handling mechanism. This approach also makes the present invention integrated well with platforms that already provide scheduling capability. On the other hand, a TS component can be made to consider function state changes only upon an incoming communication. A person who is skilled in the art will be readily able to realize this alternative. Likewise, there are different ways to provide the underlying mechanism to effect state changes of cellular phone functions, and as such the preferred embodiment of the present invention should not be bounded by any specific implementation. One who is skilled in the art will have no problems in choosing the appropriate mechanism to implement it for different platforms.

ALTERNATE EMBODIMENTS

Another embodiment is a pager, regardless of one-way or two-way paging. A distinctive difference between a pager and a cellular phone is that the former does not allow voice communications to be initiated by the user using the device alone. However, all the benefits of the present invention can be made available to a pager when embodying the present invention.

Another embodiment is a cordless phone, whose users can benefit equally from the present invention. Likewise, another embodiment is a two-way radio communications device, such as a walkie-talkie and a FRS (Family Radio Service) unit.

On the other hand, new functions may be readily added to an existing set of functions being managed under the present invention in the preferred embodiment and alternate embodiments. For example, a new feature called "no-answer auto call forward" may be made available. The feature forwards an incoming call after a pre-determined number of rings or equivalent duration, or when the user manually forces such forwarding before the number of rings or equivalent duration has occurred. The pre-determined number of rings or equivalent duration may also be configurable by a user. Other possible features include:

Audible caller identification feature – a feature that announces verbally the identity of the caller of the current incoming communication.

Caller identity display feature – a feature that displays the identity of the caller of the current incoming communication.

Caller selective auto call forward feature – a feature that forwards an incoming call based on the identity of the caller; the call may be forwarded to different destinations (e.g., a voice mailbox), and not forwarded at all (e.g., a busy tone returned to the caller).

Caller selective ringing feature – a feature that provides different ringing tones (or none) based on the identity of the callers.

(These above features provide different alerts (e.g., ringing, vibration, distinct ringing tones, distinct flashing colors, verbal announcement, and none) based on the identity of the callers.)

Moreover, a new function needs not be in the nature of handling incoming communications. An outgoing communication related feature or function is also possible, in that the user can specify a date and time to initiate a call or send a message and the destination. For example, a "scheduled communication initiation" feature may enable the user to schedule a communication to be initiated. When the event occurs, the outgoing communication is automatically made, usually upon a user confirmation like a voice (yes/no) acknowledgment or a press of a button or key. The communication need not necessarily be a voice call; it can be a login into a network, or an email send, for example.

Furthermore, new functions need not be added during the manufacture of the embodiments; they may be added in operation thereof.

INDUSTRIAL APPLICABILITY

A wireless device equipped with the present invention enables the user to control precisely, with minimum effort, when and how incoming (and possibly outgoing) communications are handled. Consequently, the user can extend to himself and those around him his desired call-receiving considerations and courtesy, while realizing the economic and convenience benefits of the optimal use of the wireless device with respect to its operating environment and characteristics. For example, the calling rate plan under which the device's wireless network service is being provided might provide unlimited calling for specific intervals of time under one single flat rate over a period of time (for example, monthly). The user can reduce the power source replacement cost, or charge less often the rechargeable power source of the device when he sets up his device to turn itself off when he does not intend to use it (for example, at night during the user's period of sleep).

CLAIMS

1. A method for scheduling an operation of a communications device, comprising the steps of:
   (a) providing a communications means for enabling said communications device to receive an incoming communication wirelessly,
   (b) providing an input means for selecting said operation and a time or time interval within which said selected operation will perform,
   (c) providing a control means for effecting said selected operation within said time or time interval.

2. A system for scheduling an operation of a communications device, comprising:
   (a) a communications means for enabling said communications device to receive an incoming communication wirelessly,
   (b) an input means for selecting said operation and a time or time interval within which said selected operation will perform,
   (c) a control means for effecting said selected operation within said time or time interval.

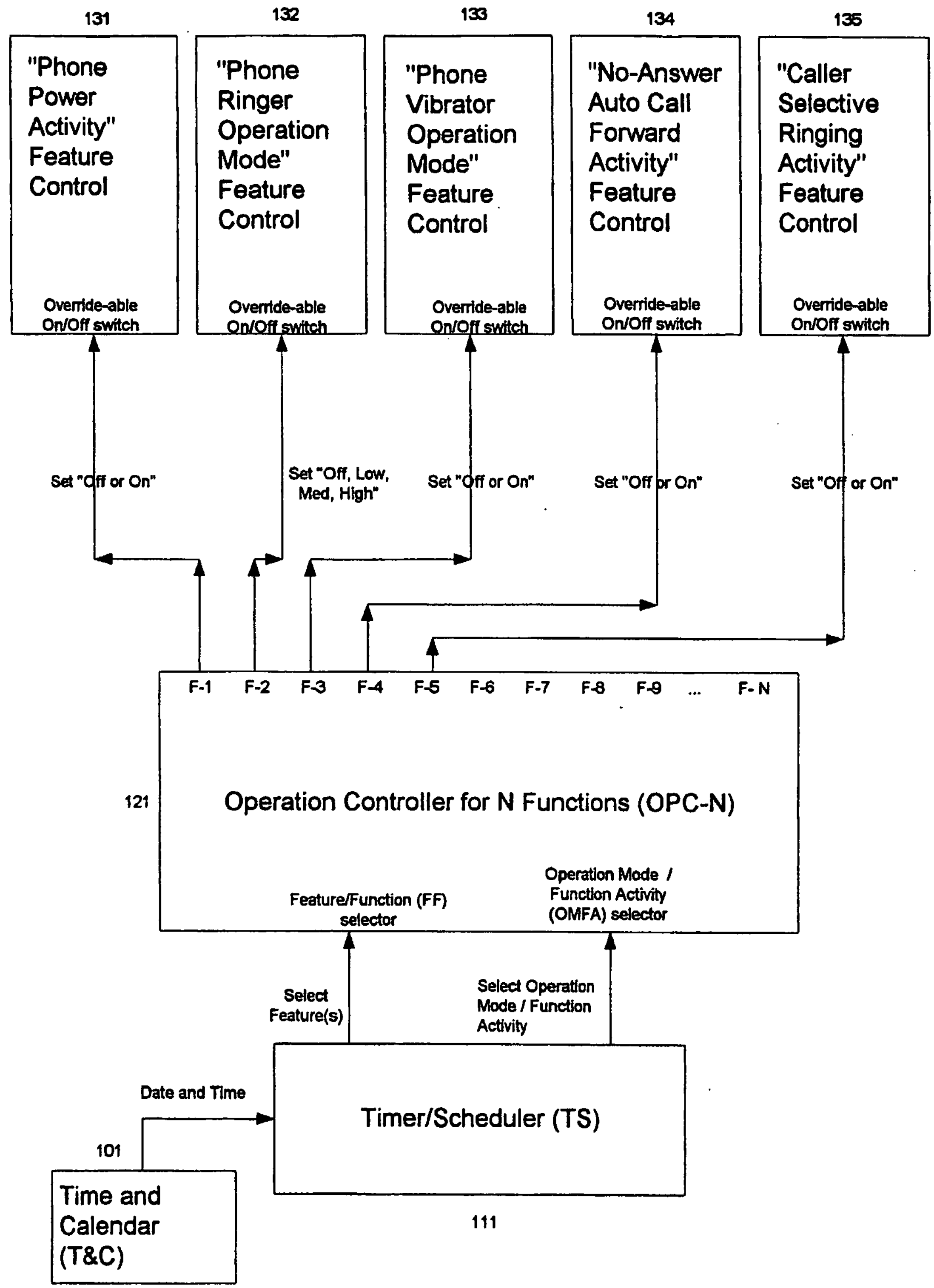

FIG. 1: Functional Components

Profile ID	Saved?	Profile Description	Suspended by User?	Trigger Record Number (See FIG. 4B)	Feature Operation Mode / Function Activity (FOMA) Specification Number (See FIG. 4C)
1	Yes	"Choir meeting"	Yes	1	1
2	Yes	"Free calls weeknights"	No	2	2
3	Yes	"Free calls weekend"	No	3	3
4	No				

FIG. 2A: TS Profiles Table

Trigger Record Number			1	2	3	4
Record State [Suspended/Active/Deleted]			S	A	A	D
Feature Operation Mode / Function Activity (FOMA) Specification Number			1	2	3	
Current Trigger State (CTS) [Start-# or End-#]			End-0	Start-3	End-0	
End?			Y	Y	Y	
Number of Repeats within Week (NRW)			0	3	0	
Weekly?			Y	Y	Y	
Start/End Trigger Day	Monday	Start		1		
		End			1	
	Tuesday	Start		2		
		End		1		
	Wednesday	Start		3		
		End		2		
	Thursday	Start		4		
		End		3		
	Friday	Start			1	
		End		4		
	Saturday	Start				
		End				
	Sunday	Start	1			
		End	1			
Start Trigger Time (hh:mm)			10:00	19:00	19:00	
End Trigger Time (hh:mm)			12:00	07:00	07:00	

FIG. 2B: Timer Trigger Table

Feature Operation Mode / Function Activity (FOMA) Specification Number	Feature 1 (e.g., Phone Power)		Feature 2 (e.g., Phone Ringer)		Feature 3 (e.g., Phone Vibration)		...	
	Profile-Start Function Activity	Profile-End Function Activity	Profile-Start Operation Mode	Profile-End Operation Mode	Profile-Start Operation Mode	Profile-End Operation Mode	...	...
1	-	-	Off	On	On	Off		
2	On	Off	-	-	-	-		
3	On	Off	-	-	-	-		
4								

FIG. 2C: Feature Operation Mode / Function Activity (FOMA) Specification Table

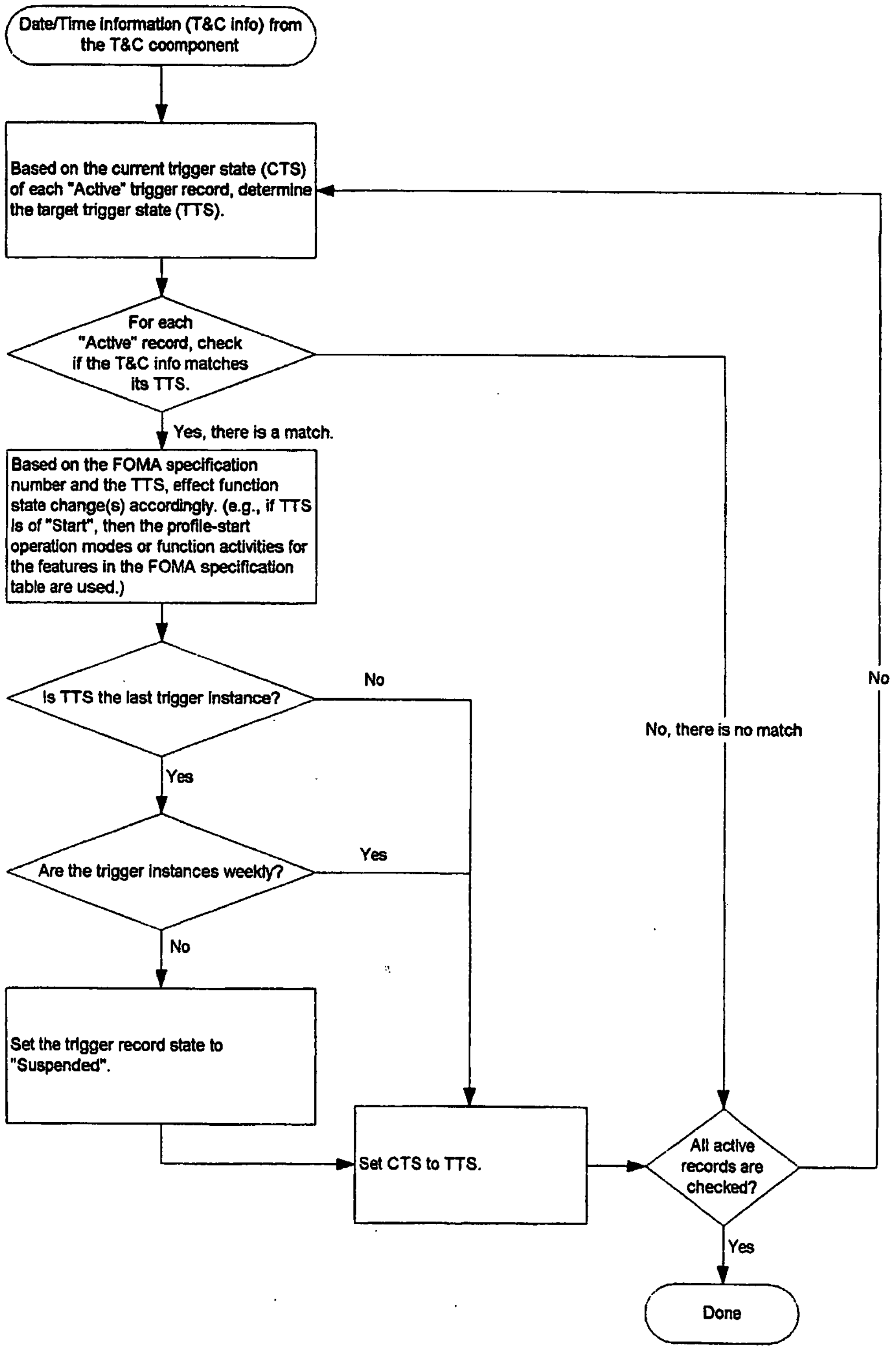

FIG. 3: Timer Processing Flowchart

State Change Request Output Interface	Feature/Function Selection with 8-Bit Identifier Values ("x" means "don't care")	Feature/Function Name and State Change Control
F-1	xxxxxxx1	Phone Power - Function Activity
F-2	xxxxxx1x	Phone Ringer - Operation Mode
F-3	xxxxx1xx	Phone Vibrator - Operation Mode
F-4	xxxx1xxx	No-Answer Call Forward - Function Activity
F-5	xxx1xxxx	Caller Selective Ringing - Function Activity
F-6	xx1xxxxx	<Port unassigned>
F-7	x1xxxxxx	<Port unassigned>
F-8	1xxxxxxx	<Port unassigned>

FIG. 4A: Feature/function Selection Table for an Operation Controller for 8 Functions

State Change Request Output Interface	Operation Mode / Function Activity Selection with 16-Bit Values ("xx" means "don't care", and "-" is just a delimiter for visual clarity.)	Semantics for Possible Values for State Change (based on the corresponding "yy" value)
F-1	xx-xx-xx-xx-xx-xx-xx-yy	yy = 00 is OFF; yy = 01 is ON. 10 and 11 are unassigned
F-2	xx-xx-xx-xx-xx-xx-yy-xx	00 is OFF; 01 is ON. 10 and 11 are unassigned.
F-3	xx-xx-xx-xx-xx-yy-xx-xx	00 is OFF; 01 is ON. 10 and 11 are unassigned.
F-4	xx-xx-xx-xx-yy-xx-xx-xx	00 is OFF; 01 is ON. 10 and 11 are unassigned.
F-5	xx-xx-xx-yy-xx-xx-xx-xx	00 is OFF; 01 is LOW; 10 is MEDIUM; 11 is HIGH.
F-6	xx-xx-yy-xx-xx-xx-xx-xx	<Port unassigned>
F-7	xx-yy-xx-xx-xx-xx-xx-xx	<Port unassigned>
F-8	yy-xx-xx-xx-xx-xx-xx-xx	<Port unassigned>

FIG. 4B: Operation Mode / Function Activity Selection Table for a Quaternary Operation Controller for 8 Functions

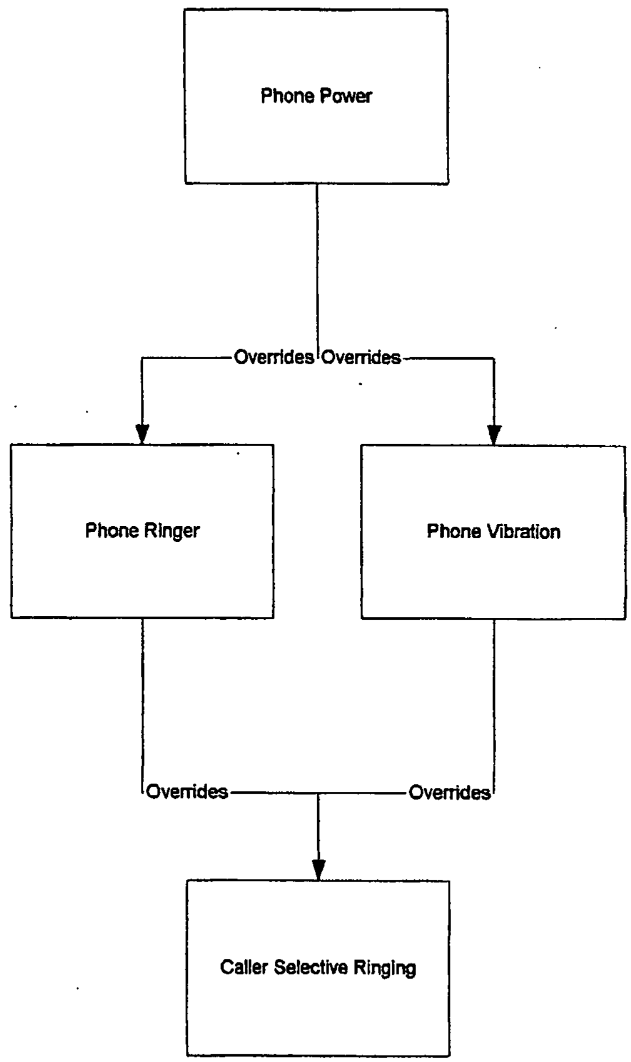

FIG. 5: Example Function Activity Overrides Hierarchy

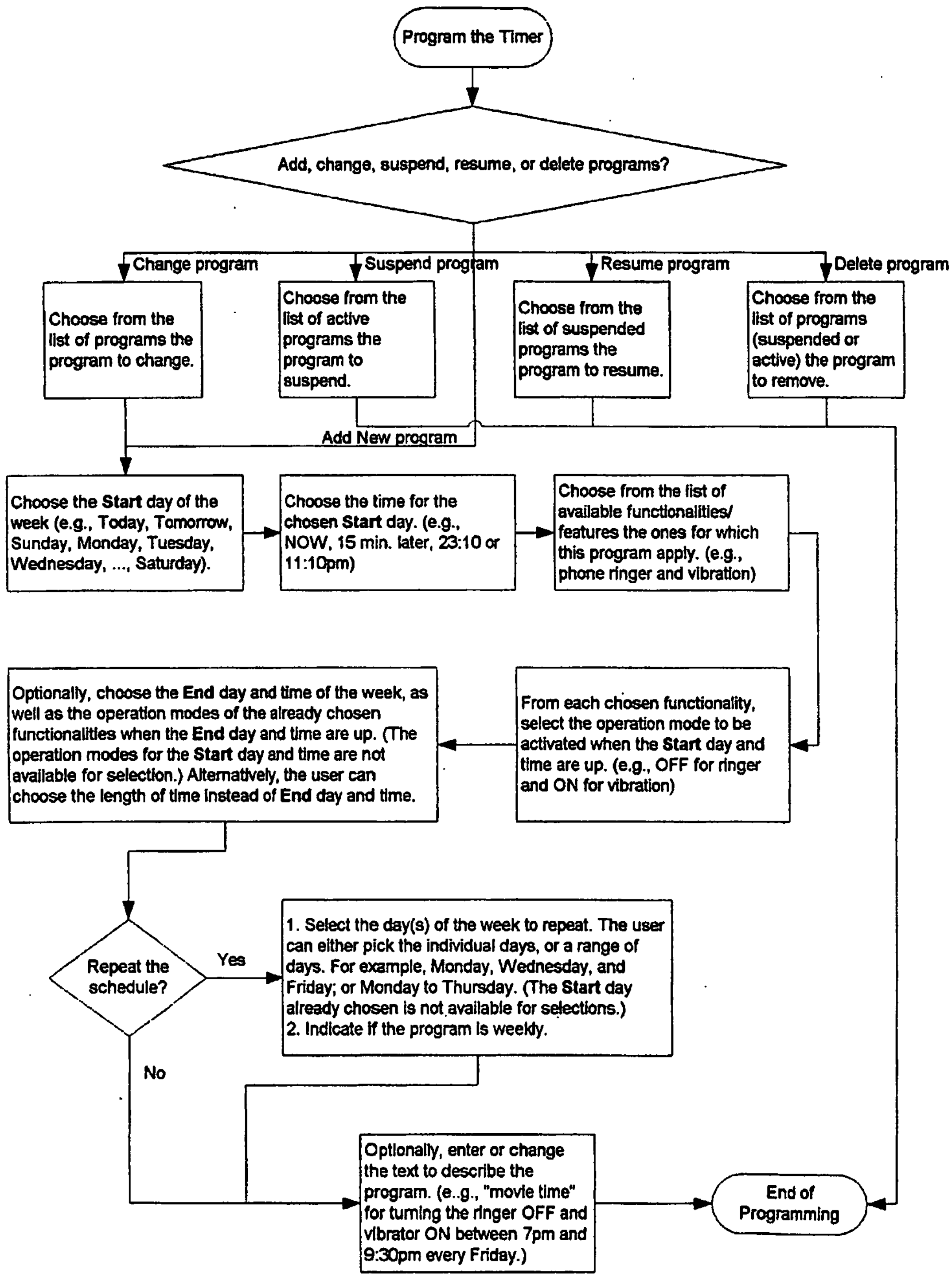

FIG. 6: Timer Programming Flowchart

INTERNATIONAL SEARCH REPORT

plication No
PCT/CA 02/00018

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04M1/72

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 98 07265 A (GATEWAY 2000 INC) 19 February 1998 (1998-02-19) page 2, line 18 -page 10, line 2 figures 1,2,4 ---	1,2
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X	EP 0 399 520 A (HITACHI LTD) 28 November 1990 (1990-11-28) column 4, line 36-49 column 7, line 37 -column 8, line 57 column 23, line 36 -column 24, line 15 figures 2,19 --- -/--	1,2

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 March 2002	28/03/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Kreppel, J

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INTERNATIONAL SEARCH REPORT

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